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In-stream water use – how much value does it carry?

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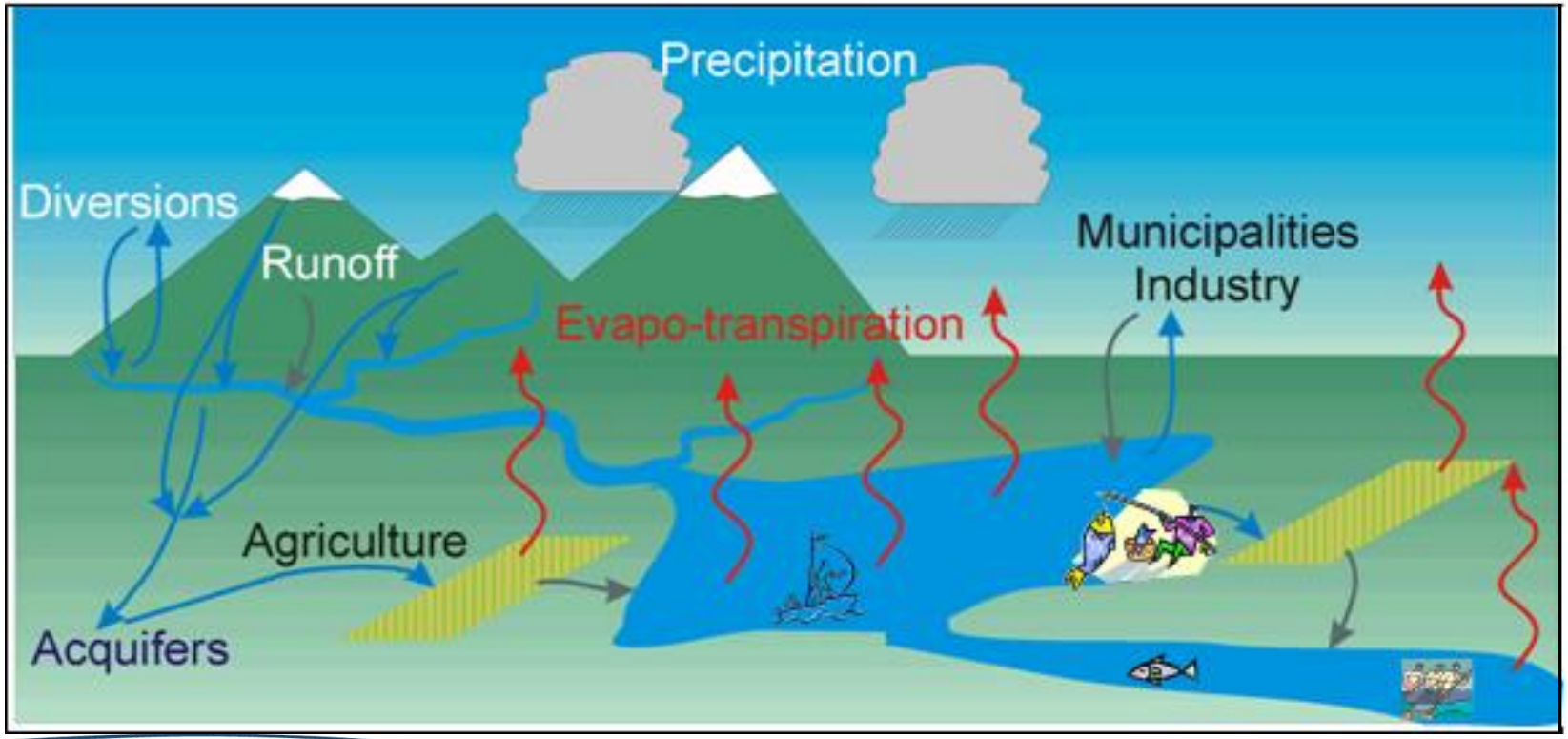
Introduction

- Rivers from SOURCE to SEA
- H_2O → from HILL to OCEAN



Introduction

- In its journey, river water gives humanity several benefits
  - contributing to economic growth;
  - determining ecosystem pattern.
- River basins are cradles of civilization.
- Several offstream and instream uses.
- In developing countries, poor riparian people are strongly tied with river flow for their life.

Introduction

- In-stream flow provides several goods and services → important economic spin-off.
- In-stream flow protection normally
  - imposes large opportunity costs &
  - results conflicts with offstream demands.

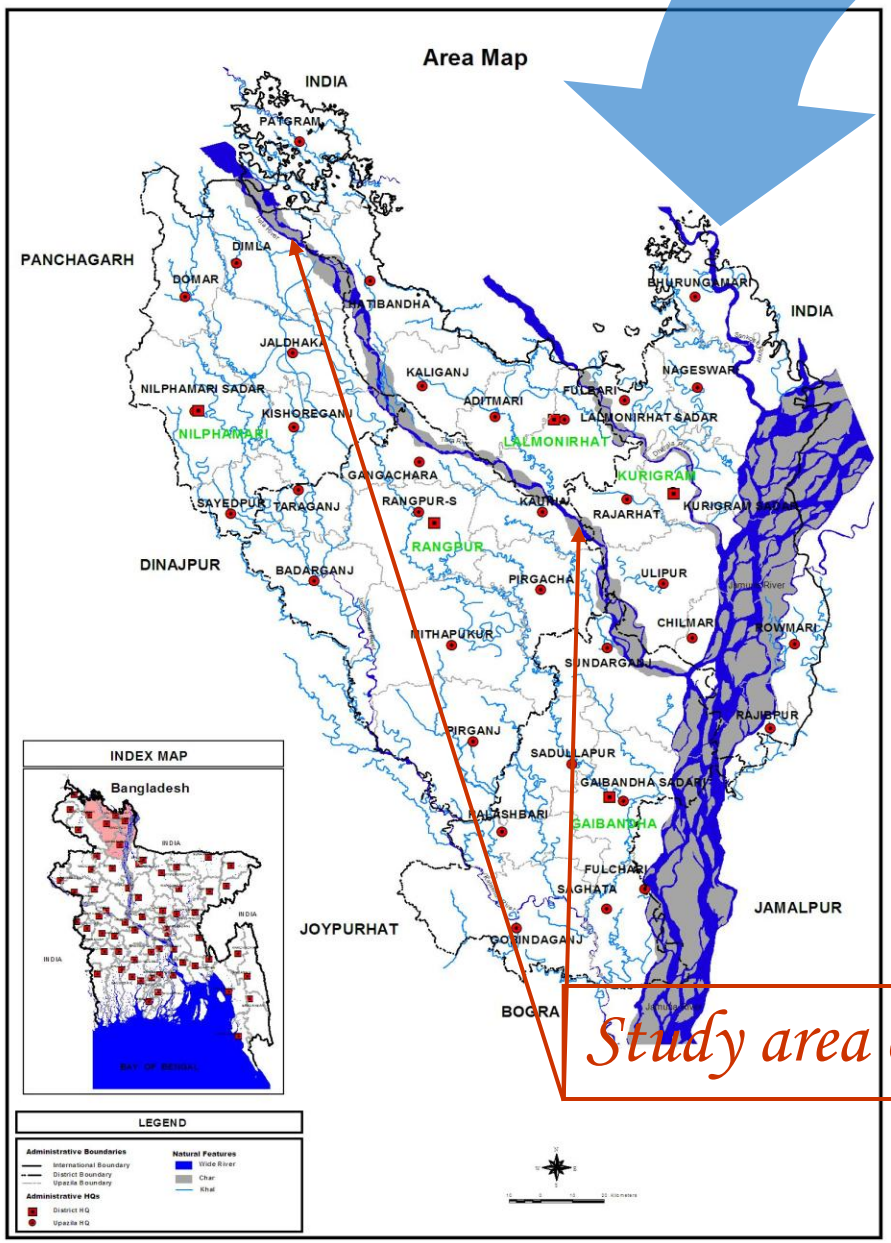
Therefore, valuation of in-stream uses will help guiding in overall basin management.

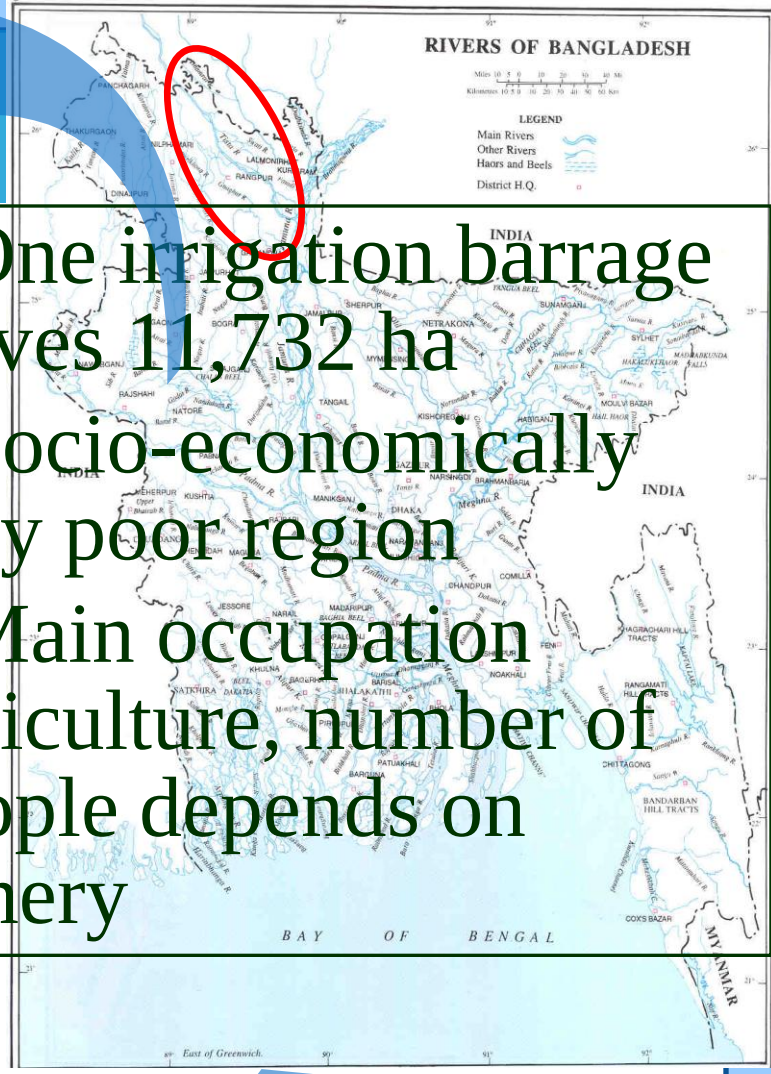
Introduction

- Some earlier works are found valuing the in-stream flow
  (Loomis 1998; Douglas & Taylor, 1998; Xu et al., 2003; Ojeda et al., 2008)
- however, valuation based on marginal benefits from in-stream water use is rarely estimated & no study done for any river in Bangladesh.

This study aims to estimate the total and marginal benefit function of in-stream water direct uses for Teesta River from Bangladesh.

Study site





- One irrigation barrage serves 11,732 ha
- Socio-economically very poor region
- Main occupation agriculture, number of people depends on fishery

Study area of Teesta river, Bangladesh

In-stream water uses

- Only the direct uses are considered
- River fishery and small scale navigation are the in-stream water uses in the Teesta.

➢ Fisheries are very important for Bangladesh.

  – 5.24% of the country's GDP & livelihood to 10% population;

  – In 2008, size of the capture fishery was 1.060 million mt & culture fishery was 1.005 million mt.

➢ Inland water transport accounts for about 15% of total transport-GDP for the country.

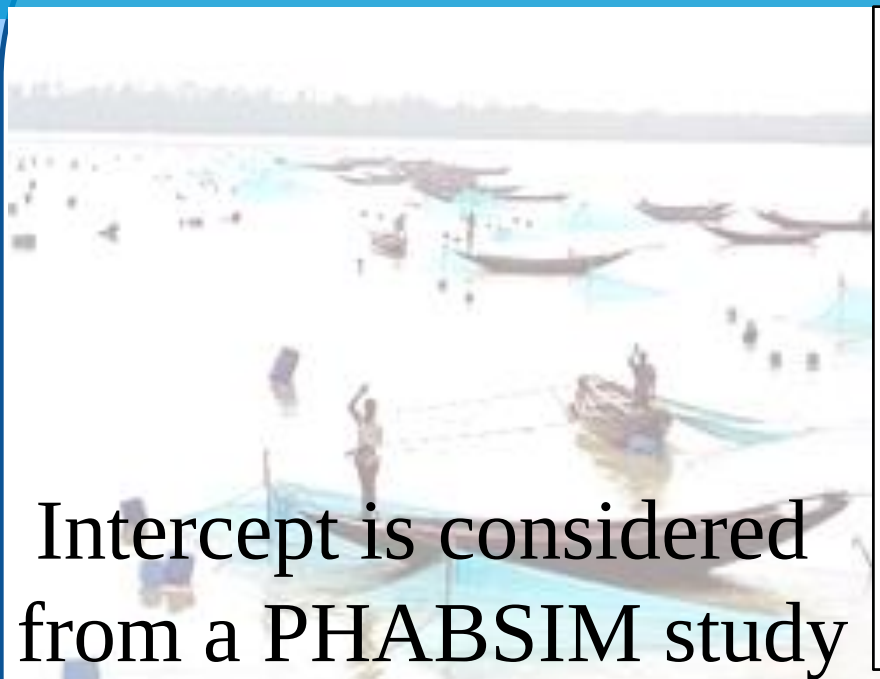
Valuation of fishery

- Needs a link between hydrology and ecology.
- However, such a link is poorly defined & still a daunting challenge due to lack of information (Young et al., 2000; IWMI, 2005, Kashaigili et al., 2005; Arthington et al., 2006).
- A flow-catch model is developed with yearly mean flow and catch.
- Yearly fish production is taken as a surrogate of the fishing effort to analyse the year-to-year trend (Baran et al, 2001) instead of considering CPUE.

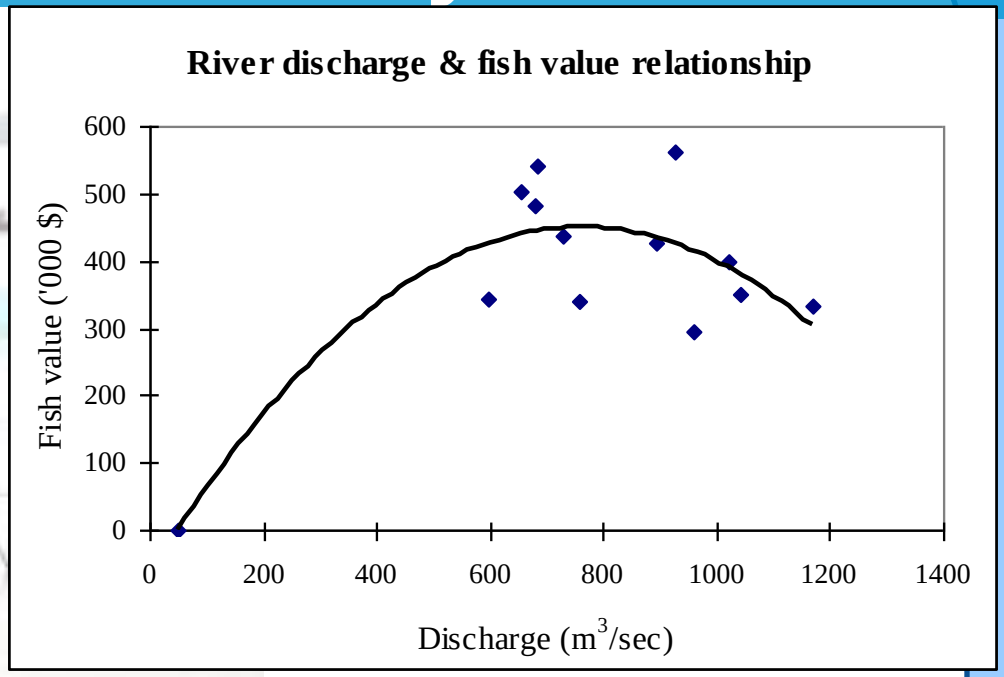
Valuation of fishery

- Substituting fish price for the fish catch
- Flow-catch model → total benefit (TB) function.
- Differentiating TB function w.r.t. flow gives the MB of water used for fishery.
- Used last 12 yrs catch and flow data

Value of fishery



Intercept is considered from a PHABSIM study



Avg Value of fishery 417,380 USD/yr

TB = -0.0009**flow*^{2} +1.3495**flow* – 63.527 (r^2 = 0.7214)

MB function, d(*TB*)/d(*flow*) = -0.0018**flow* + 1.3495

Valuation of navigation

- By primary survey on boatmen
- Value of water for navigational use = gross benefits – operating costs
- Gross benefit is considered equal of boatmen daily income
- Operating cost is negligible and considered as zero because boats are mostly manually operated

Valuation of navigation

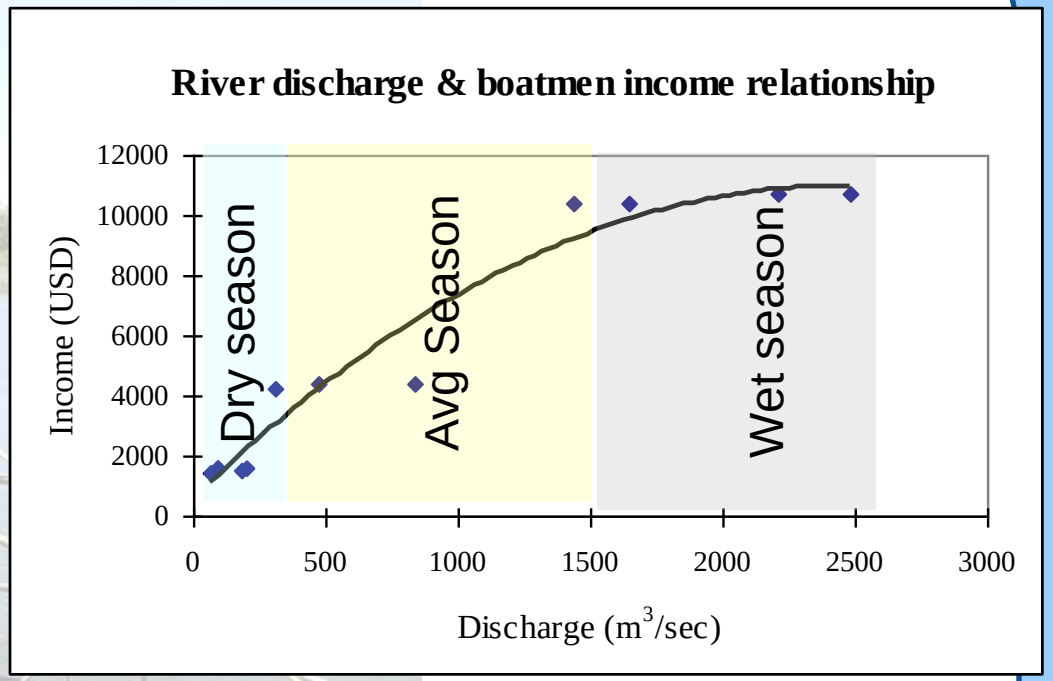
- Focus question in primary survey → daily income level at different flow level.
- Established a relationship between income variation for the boatmen and flow variation

  → total benefit function.

⇒ Differentiating total benefit function gives the marginal benefit

Value of navigation use

Daily income varies widely with flow level



Average value of navigation 62,805 USD/yr

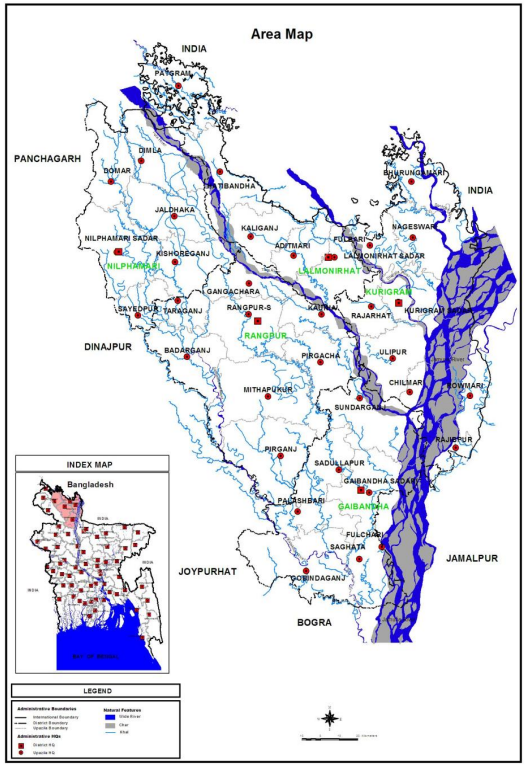
$TB = 0.0017*flow^2 + 8.1166*flow + 458.32$ ($r^2 = 0.9422$)

$MB = -0.0034*flow + 8.1166$

Discussion

- Fish production depends on natural flow regime but our fish-catch model based on avg yr. flow.
- Currently we are looking fish catch & fishermen income variation in different seasons using primary survey.

Water quality has not been considered in valuation



Conclusion

- Dry season irr demand is high and water is diverted without proper consideration of instream need.
- Farmers pay for water & Irrigation dept. earned about 56,000 USD in 2005 – 06 FY.
- On the other hand the total in-stream water use benefit is about 480,185 USD (fishery + navigation).
- Instream benefit is >8X higher.

Conclusion

- Need to rethink on dry season flow diversion as fishery is sensitive to dry season flow.
- Results from this analysis will help water manager in allocating the minimum in-stream flow
  - and subsequently will support
    - → the river and ecosystem,
    - → the riparian poor's livelihood with overall socio-economic development.

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Thank you for your attention